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Da cooperação entre Max-Planck-Institut für Limnologie, Arbeitsgruppe Tropenökologie, Plön, Alemanha Oc., e Instituto Nacional de Pesquisas da Amazônia, Manaus – Amazonas, Brasil

A new species of *Ribautiella* (Myriapoda, Symphyla, Scolopendrellidae) from an Amazonian black-water inundation forest and notes on its natural history and ecology

by

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Abstract

Ribautiella amazonica is described from a black-water inundation forest near Manaus, Brazil. The genus is recorded for the first time for the Americas. *R. amazonica* was predominantly collected from the forest soil, mainly between 7 and 14 cm depth and is considered euedaphic. Data indicate, that advanced immature stages and adults withstand forest-inundation of 5 - 6 months duration in the soil and reproduce in the early part of the emersion period.

Keywords: **Symphyla, soil fauna, inundation forests, Neotropic, Brazil.**

Introduction

Black-water inundation forests (= Igapós) in the Manaus, Brazil area, are annually flooded for 5 - 6 months. Reaction of their arthropod fauna to inundation was investigated in 1976/77 and in 1981/82 with a 'minimal program for ecosystem analyses' and a soil extraction method (ADIS 1981; ADIS & SCHUBART 1984). Results revealed that numerous arthropods, particularly non-flying ones, survive in the trunk-canopy area during the

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period of inundation, as for example the symphylan *Hanseniella arborea* (Scutigerellidae; SCHELLER 1979; ADIS & SCHELLER 1984). The non-flying and limited flying arthropod fauna of the Igapó were classified into "terricole" and "arboricole" groups consisting of "nonmigrants" and "migrants" (ADIS 1981). *Ribautiella amazonica*, herein described, represents the terricolous nonmigrating group. The genus is recorded for the first time for the Americas.

Study area and methods

The study site was situated on the lower course of the Rio Tarumã Mirim (03°02' S, 60°17' W), an affluent of the Rio Negro, about 20 km upstream from Manaus. Its inundation forest represented an 'upper seasonal igapó' and is described in detail by ADIS (1981, 1983a) and IRMLER (1975, 1977). The Igapó under study was flooded up to 3.35 m above ground from March/April to August/September. It was subject to a rainy season (June-November) and a dry season (December-May). Capture devices used are fully described by ADIS (1981) and FUNKE (1971) and were utilized between January, 1976, and May, 1977. On the forest floor eight ground photo-eclectors and two pitfall traps provided data on activity densities during the non-inundation period. Arboreal photo-eclectors detected trunk ascents and trunk descents on three tree trunks each throughout the collecting period. Distribution of symphylans in the soil was studied between September, 1981 and February, 1982 (non-inundation period). Once a month (cf. Table 1) six soil samples were taken at random along a transect with a split corer (= steel cylinder with lateral hinges; ϕ: 21 cm), which was driven into the soil by a mallet. Each sample of 14 cm depth was then divided into four subsamples of 3.5 cm each. Animals were extracted from subsamples following the method of KEMPSON et al. (1963).

Symphylans collected were classified as juveniles (up to 10 pairs of legs), subadults (11 pairs of legs) and adults (12 pairs of legs). For juveniles with 10 pairs of legs, subadults and adults sex was determined according to CHARDARD (1947). The taxonomical work for this paper was done by U. SCHELLER, the collection and evaluation of field data by J. ADIS.

Distribution of the genus *Ribautiella*

Although families and some genera of Symphyla are distributed without much regard to the climatic zones, climate seems to influence the range of *Ribautiella*. This genus was established in 1926 by BRÖLEMANN, who described *R. zagnanadina* from Dahomey. The species was later reported also from Angola (HINSCHBERGER 1954a; ROCHAIX 1955; JUBERTHIE-JUPEAU 1958) and from the Ivory Coast (HINSCHBERGER 1954a; ROCHAIX 1955). Three more species have been reported from west Africa. Two of them, *R. schoutedeni* and *R. machadoi*, both described by HINSCHBERGER, are closely related to *R. zagnanadina*. The former was reported from Angola (HINSCHBERGER 1954a; JUBERTHIE-JUPEAU 1958), Ivory Coast (HINSCHBERGER 1954a) and Zaire (HINSCHBERGER 1954a, b) and the latter from Angola (HINSCHBERGER 1954a; JUBERTHIE-JUPEAU 1958) and Ivory Coast (HINSCHBERGER 1954a). A third, but quite different species, *R. remyi*, was described from Angola by HINSCHBERGER (1954a). It has some peculiar characters which indicate that it may belong to a subgenus of its own.

Besides these four species from west Africa, two more are known to occur on the islands to the east of Africa: *R. borbonica* described from Réunion (JUPEAU 1954), but

occurring also on Madagascar (ROCHAIX 1956), and *R. delphini* known from the latter island only (ROCHAIX 1956).

All these finds lie within the warm belt, and the new Neotropical species from Brazil emphasizes the tropical character of the genus.

Systematics

Family Scolopendrellidae
Genus *Ribautiella* BRÖLEMANN
Ribautiella amazonica SCHELLER, n. sp.

Type locality. – Brazil, Manaus, at Rio Tarumã Mirĭm.

Type material. – Holotype: Manaus, at Rio Tarumã Mirĭm, black water region, inundation forest, (Igapó/soil extraction (K) – (Loc. TM 81/82, K 24), 1981. XI. 30. label data; collecting data (cf. Table 1) are given in parenthesis, (XI. 21.), ad.* ♀, (leg. Joachim Adis). In the Systematic Entomology collections of Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Brazil.

Paratypes: Same place, pitfall trap (BoF 27), 1977. I. 6, 1 subad. 11 (♂); same place, K 24, 1981. XI. 30. (21.), 2 ad. (♂, ♀), 5 subad. 11 (3 ♂, 2 ♀), 8 juv. 10 (3 ♂, 5 ♀), 2 juv. 8; same place, K 11 - 13, 15 - 21, 24 - 25, 28 - 29, 31 - 33, 1982. II. 1. (I. 21.) and 1982. III. 3. (II. 17.), 20 ad. (9 ♂, 10 ♀, 1 sex ?), 7 subad. 11 (2 ♂, 5 ♀), 17 juv. 10 (5 ♂, 11 ♀, 1 sex ?), 22 juv. 9, 18 juv. 8, 2 stad. ? , in the Systematic Entomology collections of Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil; same place, K 11 - 14, 16 - 23, 25, 27 - 33, 1981. IX. - XII., 28 ad. (16 ♂, 12 ♀), 19 subad. 11 (10 ♂, 9 ♀), 17 juv. 10 (4 ♂, 12 ♀, 1 sex ?), 12 juv. 9, 7 juv. 8, in author's collection.

Type material: 188 specimens.

Non-type material: 23 specimens; same place, K 11, 13, 17, 19, 20, 23, 25, 27, 29, 31, 33, 1981. IX. – 1982. III. (II.), 7 ad.♀, 4 subad. 11 (1 ♂, 3 ♀), 4 juv. 10 (♀), 4 juv. 9, 4 juv. 8, in author's collection.

Length.** – (1.4 -) 2.1 (- 2.6) mm.

Head. – Head (1.3 -) 1.5 times as long as broad without distinct lateral angles at points of articulation of the mandibles; broadest behind the middle; posterolateral margins evenly rounded. Central rod indistinct, posterior part broadest, (1.1 -) 1.2 times as long as anterior part; frontal branches vestigial, median ones lacking. Tergal side of head covered sparsely with thin straight setae. Postantennal organ two-parted (generally two-parted), 1.5 (- 1.6) times as long as broad; opening on anterior part. Palp of first maxilla bud-like; (2.8 -) 3.0 (- 3.5) times as long as broad with 3 distal points, the median one longest and also most pointed; lateral ones curved inwards, inner one longer than outer one. Cuticle of head granular.

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* Abbreviations: ad. = a specimen with the maximum number of legs; juv. = a juvenile specimen with the number of pairs of legs indicated. These numbers include the rudimentary first pair of legs.

** Length of body except antennae and cerci; range of variation in paratypes is given in parenthesis.

Table 1: Development stages of *R. amazonica* in soil samples taken to a depth of 14 cm between September, 1981 and February, 1982 at Rio Tarumã Mirim; p = pairs of legs.

month	juvenile				subadult		adult		total
	8 p	9 p	10 p		11 p		12 p		
			♂	♀	♂	♀	♂	♀	
September 21, 1981	–	–	–	3	1	3	5	3	15
October 19, 1981	–	3	–	–	–	–	–	–	3
November 19, 1981	8	6	7	16	9	9	9	10	74
December 17, 1981	2	4	–	1	3	2	3	6	21
January 21, 1982	15	9	2	12	2	3	3	8	54
February 17, 1982	6	16	3	2	1	–	6	4	38
Total	31	38	12	34	16	17	26	31	205

Antennae. – Antennae with (16 -)18 (- 27) segments (subad. 11 have generally 15, juv. 10 have 14, juv. 9 have 13 and juv. 8 have 12 segments). Antennae 0.2 of the length of body (even in subadult and juvenile specimens). **First segment** thinner than following ones, almost cylindrical, 1.1 times as broad as long; it has 6 thin setae in a single whorl, 3 of them on inner side. The latter are longest, (1.3 -) 1.5 (- 1.6) times as long as outer setae and 0.5 of greatest diameter of the segment. Longest setae of proximal segments (3.0 -) 3.4 (- 4.6) times as long as those of apical segment. **Second segment** with 8 (- 9) setae. Proximal part of antennae with one whorl of setae on each segment, secondary whorl begins on segment 6 (- 8) but disappears distally. Circular sensory organs on the tergal side of segments (6 -) 7 (- 13) to (16 -) 17 (- 26). Bladder-shaped organs on the distal segments (11 -) 13 (- 17) to 17 (- 26), at most 10 (- 11) of them. Small spined organs are to be found on tergal side of most segments from segment 2 to (16 -) 18 (- 24) and on the apical one. **Apical segment** subglobular with a few very short thin setae. In depressions in the distal half there are (5 -) 6 short spined organs with a blunt central pillar surrounded by curved spines. All segments with a distinct pubescence.

Tergites. – There are 24 tergal plates, 13 of them with triangular posterior processes. Tergites 4, 5, 7, 8, 10, 11, 13 and 14 are undivided, tergites 1, 2, 3, 6, 9, 12, 15 and 16 divided; no setae on the triangular processes. **First tergite** rudimentary, short, with 6 thin setae in an almost straight row on its posterior part. **Second tergite** complete; anterior part with 4 setae in one row, posterior part with 4 setae in an anterior row and 5 in a posterior one; triangular processes blunt without end swellings. **Third tergite** with 8 and 11 setae on anterior and posterior part respectively. The ratio of the distance between the triangular processes (measured between inner basal setae) to their length (measured from inner basal setae) is 1.4 (- 1.5) on 2nd tergite and (1.4 -) 1.5 on 3rd one. There is one seta between inner basal setae on anterior tergites. All the setae thin, insertion areas indistinct; no long anterolateral setae. Cuticle of tergites finely granular; triangular processes also with short pubescence atranged in a few rows lengthways.

Legs. – **First pair** of legs reduced to two, small, two-parted knobs; they are pubescent, each part with a subapical seta. There are 8 setae between the legs. **Last pair** of legs with a subcylindrical **tarsus** which narrows at distal end. It is (2.3 -) 2.7 (- 3.0) times as long as wide with 6 setae, all on distal third and 4 of them on tergal side; 3 tergal setae are long, straight, erect, one is depressed, slightly curved; longest seta about as long as greatest diameter of the tarsus and (0.4 -) 0.5 of length of the tibia. **Tibia** (1.9 -) 2.1 (- 2.2) times as long as wide with 4 (- 5) setae on tergal and anterior sides of distal part; longest seta is a tergal one which is (0.7 -) 0.8 (- 0.9) of greatest diameter of the segment and almost as long as the longest seta on tarsus. **Femur** about as long as wide with 4 (- 5) subequal setae on tergal and anterior sides of distal part. **Trochanter** with (4 -) 5 subequal setae. **Claws** of about the same length with thin distal halves; anterior claw slightly curved, posterior one sickle-shaped. **Styli** at bases of legs 3 - 12, conical, (3.0 -) 3.4 - 4.5 (- 4.7) times as long as their greatest diameter; they are pubescent and have a thin distal hair. Between the legs of the 11th and 12th pair there is to be found a pair of shortly pubescent **circular organs**; they are located just anterior to the coxal plates; distance between posterior ones is (0.4 -) 0.5 (- 0.7) of the distance between anterior ones. Such organs are also to be found between the legs of the last pair in the stages with 8 - 11 pairs of legs. There are 8 pairs of **coxal sacs** at bases of legs 3 - 10 (ad. and subad. 11), 7 at legs 3 - 9 in juv. 10 and 6 at legs 3 - 8 in juv. 8. **Coxal plates** of leg 11 with 1 (- 3) setae, those of leg 12 with 1 (- 2) setae.

Cerci. – Cerci (2.8 -) 2.9 (- 3.0) times as long as wide with tergal and inner sides almost straight, sternal and outer ones curved. They are proportionately very short, 0.03 (- 0.04) of length of the body. They have thin, straight, oblique setae on tergal, outer and sternal sides. Sternal setae (most often) longer than tergal ones. Longest tergal row with (3 -) 4 (- 5) setae; longest seta about 0.5 of greatest diameter of the cercus. Terminal area two-parted by a transversal stria. There are two apical setae; the inner one straight and longer than the terminal area, (0.6 -) 0.7 of greatest diameter of the cercus; outer seta curved, about 0.5 of longer seta. Pubescence fine, dense; terminal area granular.

Affinities. – The occurrence in *R. amazonica* of sternal posterior circular organs seems to isolate it from all the other species of the genus, but this type of organ is not unique to it. Organs which may be similar to the ones described above have been observed in some specimens of *Scolopendrellopsis subnuda* (HANSEN) from Europe by JUBERTHIE-JUPEAU & TABACURU (1968: 500, 501): "petite formations ventrales, subcirculaires" . . ." "situés dans l'angle formé par le subcoxite et la plaque remplaçant la vésicule coxale au niveau de la 11^{e} paire de pattes". As these authors noted they seem not to be identical to the enigmatic structure observed by RIBAUT (1931: 148) on the sternal side of the segments 5 - 9 in *Scolopendrella notacantha* GERVAIS but it may be that sternal circular organs have been overlooked and are more widespread than now known. It is not possible to exclude their occurrence in other *Ribautiella* species. Disregarding these organs, the new species appears closest to the West African group of species consisting of *R. schoutedeni, machadoi* and *zagnanadina.*

Key to the species of *Ribautiella*

As the literature of the genus is scattered and no review of the species has been published a preliminary key including all the species now known is given:

1. All tergites with posterior margin straight; trichobothrium foliate ..... *remyi* HINSCHBERGER 1954
– 12 or 13 tergites with posterior triangular processes; trichobothrium thin, threadlike 2
2. First tergite with 8 setae; terminal area of cerci with 7 - 8 striae ..... *borbonica* JUPEAU 1954
– First tergite with 6 setae; terminal area of cerci with 2 - 5 striae 3
3. 2nd tergite undivided; st short, rounded ..... *delphini* ROCHAIX 1956
– 2nd tergite divided; st slender, pointed 4
4. Anterior sclerite of 2nd tergite with 4 - 6 setae 5
– Anterior sclerite of 2nd tergite with 9 - 12 setae 6
5. Anterior sclerite of 2nd tergite with 4 setae; terminal area of cercus with 2 striae ..... *amazonica* n. sp.
– Anterior sclerite of 2nd tergite with 6 setae; terminal area of cercus with 4 - 5 striae ..... *schoutedeni* HINSCHBERGER 1954
6. Anterior sclerite of 2nd tergite with 9 setae; cerci sparsely setose, all their setae short ..... *machadoi* HINSCHBERGER 1954
– Anterior sclerite of 2nd tergite with 12 setae; cerci densely setose, some setae protruding ..... *zagnanadina* BRÖLEMANN 1926

Natural history and ecology of *Ribautiella* species

No *Ribautiella* species is widely distributed, but *R. zagnanadina* has been collected from many places in tropical West Africa. It seems also to have a wide habitat spectrum: hiemilignosa, ericilignosa, durilignosa, savanna, gallery forest, rain forest. The cultivation of land has also forced it into secondary forests and parks. The species is presumably euedaphic though it sometimes was found under leaves and boards. Systematic collection for study of its natural history has not been made but subadults and juveniles have been found in most months. Two more species, *R. schoutedeni* and *R. machadoi*, have been found in the same areas and may be adapted to similar edaphic conditions as *R. zagnanadina*.

As to the rest of the species, the low number of specimens and localities give poor information: *R. borbonica* has been collected only in a few man-modified localities and *R. remyi* and *R. delphini* are each known from a single specimen, however, collected at places which may be primary habitats.

Accordingly very little is known about the natural history of the *Ribautiella* species previously described and the available information of their ecology is insignificant. Therefore the occurrence of *R. amazonica* in a considerable number in the soil samples from the Igapó was of interest. In total, 211 specimens of *Ribautiella amazonica* have been collected:

210 were extracted from soil samples in 1981/82, and one subadult male was captured with pitfall traps in January, 1977. Sex ratio of adult males and females was 1 : 1.2. At no time did *R. amazonica* occur in ground and arboreal photo-eclectors as, for example shown for *Hanseniella arborea* from the same biotope (ADIS & SCHELLER 1984; SCHELLER 1979). In the course of repeated field studies between January, 1976 and May, 1983, especially during the inundation period, *R. amazonica* was never collected from tree trunks (e. g. under loose bark, in moss), in epiphytes, nor with canopy fogging (ADIS 1983b). About 86 % of all specimens extracted from soil samples occurred below 7 cm depth, irrespective of their developmental stage (Fig. 3). Very rarely they came to the soil surface and were caught in, e. g., pitfall traps. The species is therefore considered euedaphic, i. e. inhabiting lower soil-layers (cf. TOPP 1981). In the Igapó under study, the soil consisted of clay, silt and sand material with alternating fractions (IRION & ADIS 1979). Its A-horizon of 10 - 15 cm depth was composed of a matting of roots with fine humus in the upper part and mineral soil in the lower part. Symphylans are reported to follow fissures left by decaying roots, earthworm burrows, etc. in compacted subsoils (MICHELBACHER 1938) and to migrate as far as 1.5 m depth in the soil (KAESTNER 1963; PRICE & BENHAM 1977). Favoured by its small size, *R. amazonica* may therefore live below 14 cm depth as well. Its highest population density in the soil was recorded in November, 1981, with 356 ind./m^2 (0 - 14 cm depth) and overall Symphyla amounted to 423 ind./m^2, if the second species, *Hanseniella arborea*, is included (cf. ADIS & SCHELLER 1984). A correlation between the population density and weather conditions in the area could not be found. Preliminary examination of gut contents of *R. amazonica* revealed pigmented fungal hyphae but no arthropod material, as observed in *Hanseniella arborea.*

Up to now, data indicate that advanced juvenile stages, subadults and adults of *R. amazonica* withstand flooding in the soil and that reproduction takes place in the early part of the non-inundation period (Table 1). Ten specimens of *R. amazonica* (1 ad. ♂, 1 ad. ♀, 8 juv. 9) were extracted from soil samples which were taken from the inundated forest in mid-July, 1981 and kept moist in the laboratory until mid-September. Flood resistance is already known to occur in other terricolous arthropod groups of the Igapó, especially in small species, e.g. adult Acari (*Rostrocoetes foveolatus;* Oribatidae; BECK 1972) and immature Diplopoda (Pyrogdesmidae; ADIS et al., in prep.) as well as in larger species, e.g. Coleoptera larvae (*Sisenopiras gounellei*; Oedemeridae) found in decaying wood under water (ADIS, ARNETT, unpubl.).

Resumo

Ribautiella amazonica é descrita de uma floresta de inundação na região da água prêta perto de Manaus, Brasil. O genero é indicado pela primeira vez para as Américas. *R. amazonica* foi coletada na sua maioria no solo da floresta, principalmente entre 7 e 14 cm de profundidade, e é considerada euedáfica. Os dados indicam, que avancados estágios imaturos e adultos resistem a inundação da floresta com 5 até 6 meses de duração no solo e reproduzem no primeiro período da fase emersa.

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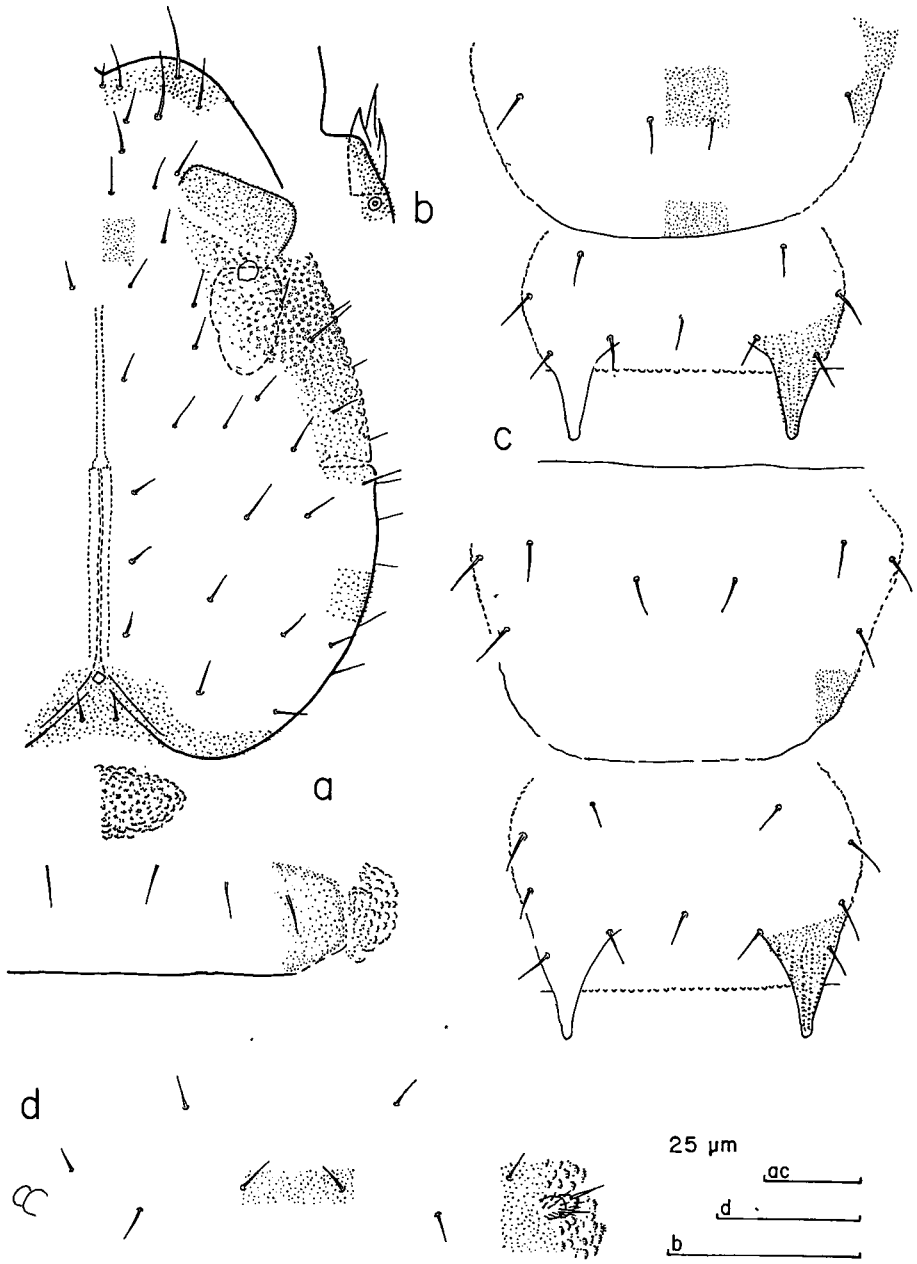

Fig. 1:
Ribautiella amazonica n. sp., holotype. a. Head and tergite 1, right half. b. Palp of first maxilla, left side, sternal view. c. Tergites 2 - 3. d. First pair of legs, sternal view. Cuticular surface structures only partly drawn.

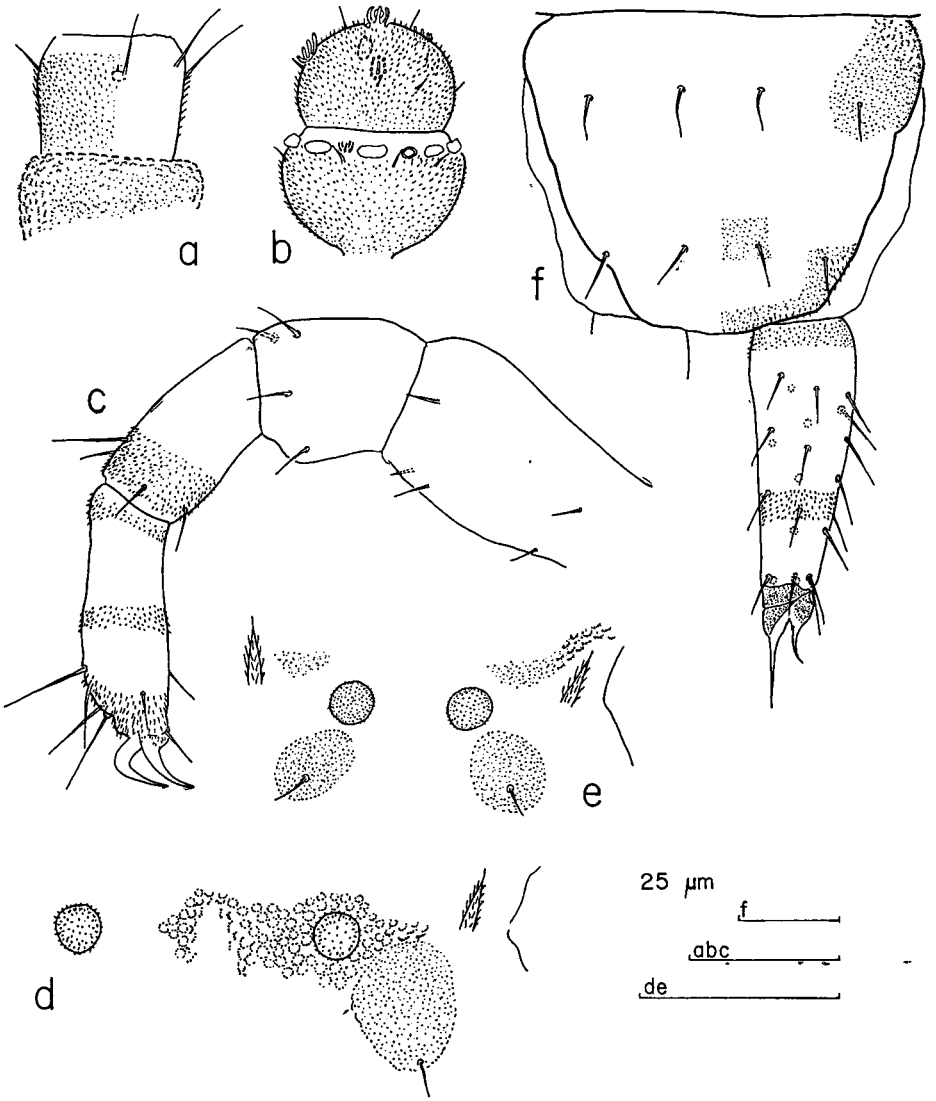

Fig. 2:
Ribautiella amazonica n. sp., holotype. a - b. Antenna, left side, tergal view: a, base and first segment; b, last two segments. c. 12th leg, right side, anterior view. d - e. Styli, circular organs and coxal plates: d, leg 11; e, leg 12. f. Tergite 16 and right cercus, tergal view. Cuticular surface structures only partly drawn in a and c - f.

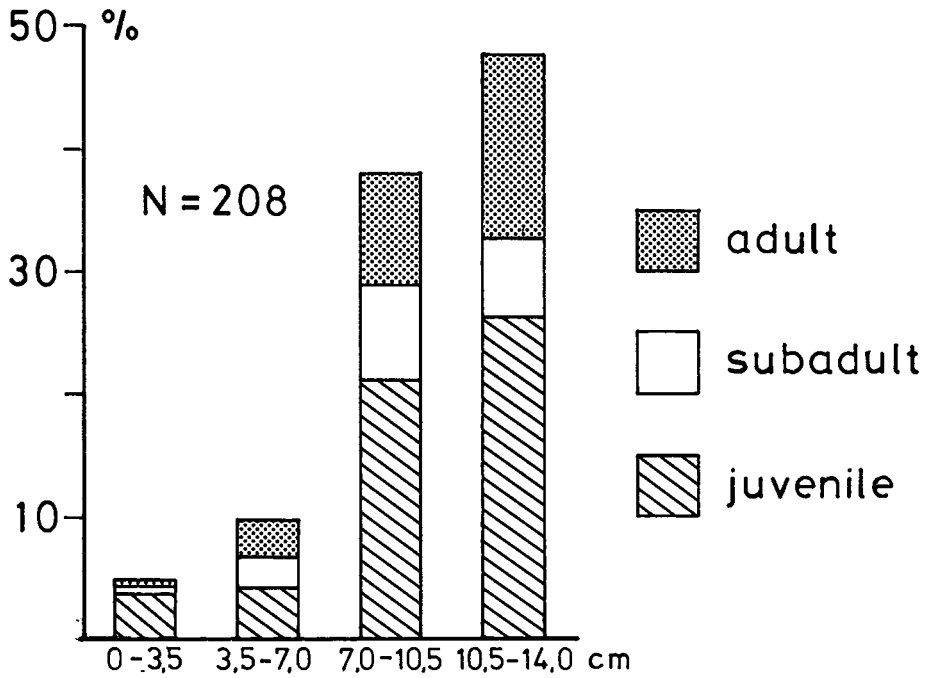

Fig. 3:
Distribution of *R. amazonica* in the soil (%). Samples taken every 3.5 cm to a depth of 14 cm between September, 1981 and February, 1982 (emersion period) at Rio Tarumã Mirím; total catch = 100 %.